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UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES

Ex parte PAUL MARIE AYOUB, STEVEN C. SUMROW,
HENK DIRKZWAGER and BRENDAN DERMOT MURRAY

Appeal 2009-0209
Application 10/772,023
U.S. Patent Publication 2004-0176655
Technology Center 1700

Decided:[1] February 19, 2009

Before: JAMES T. MOORE, *Vice Chief Administrative Patent Judge*,
FRED E. McKELVEY, *Senior Administrative Patent Judge*,
and SALLY GARDNER LANE, *Administrative Patent Judge*.

McKELVEY, *Senior Administrative Patent Judge*.

DECISION ON APPEAL

A. Statement of the case

Shell Oil Company ("Shell"), the real party in interest, seeks review under 35 U.S.C. § 134(a) of a final rejection (mailed 10 October 2006) of claims 1-43 as being unpatentable under 35 U.S.C. § 103 over

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[1] The two-month time period for filing an appeal or commencing a civil action, as recited in 37 CFR § 1.304, begins to run from the date shown on this page of the decision. The time period does not run from the Mail Date (paper delivery) or Notification Date (electronic delivery)

(1) Marinangeli 1, U.S. Patent 6,187,981 B1, (2) Marinangeli 2, U.S. Patent 6,111,158, and, (3) as to some claims, Funk, U.S. Patent 5,523,503.

Marinangeli 1 and 2 and Funk are prior art under 35 U.S.C. § 102(b).

We have jurisdiction under 35 U.S.C. § 134(a).

B. Findings of fact

The following findings of fact are supported by a preponderance of the evidence. To the extent that a finding of fact is a conclusion of law, it may be treated as such. Additional findings as necessary may appear in the Discussion portion of the opinion.

Claims on appeal

Claims 1-43 are on appeal.

Claim 44-281 also appear in the application on appeal, but have been withdrawn from consideration based on restriction requirements. Final Rejection, page 2.

In presenting the appeal, Shell does not single out claims 2-43 for separate consideration.

Accordingly, we will decide the appeal on the basis of claim 1. 37 C.F.R. § 41.37(c)(1)(vii) (2008).

The invention

The invention on appeal relates to method for preparing branched alkyl aromatic hydrocarbons. Specification, page 1:10-11.

The invention can generally be understood with reference to Fig. 1 of the drawings of the application and claim 1 below.

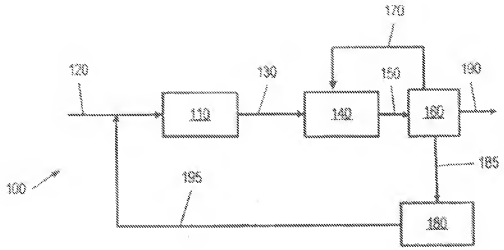


FIG. 1

Figure 1 depicts a schematic diagram of an embodiment of a system for producing branched alkyl aromatic hydrocarbons using an olefin isomerization unit.

With reference to Fig. 1, claim 1 on appeal reads [some indentation, drawing numbers and bracketed matter added]:

Claim 1

A method for the production of alkyl aromatic hydrocarbons, comprising:

[1] introducing [via 1st conduit 120] a first hydrocarbon stream comprising [a] olefins and [b] paraffins into an isomerization unit 110,

wherein the isomerization unit 110 is configured to isomerize at least a portion of linear olefins in the first hydrocarbon stream 120 to branched olefins, and

wherein at least a portion of the unreacted components [non-isomerized linear olefins and unreacted paraffins] of the first hydrocarbon stream 120 and at least a portion of the produced branched olefins form a second hydrocarbon stream [in 2d conduit 130];

[2] introducing [a] at least a portion of the second hydrocarbon stream 130 and [b] aromatic hydrocarbons [not shown] into an alkylation unit 140,

wherein the alkylation unit 140 is configured to alkylate [a] at least a portion of the aromatic hydrocarbons with [b] at least a portion of the olefins in the second hydrocarbon stream 130 to produce alkyl aromatic hydrocarbons,

wherein at least a portion of the produced alkyl aromatic hydrocarbons comprise a branched alkyl group, and

wherein [a] at least a portion of the unreacted components of the second hydrocarbon stream 130, [b] at least a portion of the aromatic hydrocarbons and [c] at least a portion of the produced alkyl aromatic hydrocarbons form an alkylation reaction stream [in 3d conduit] 150;

[3] separating alkyl aromatic hydrocarbon from the alkylation reaction stream [in separator 160] to produce [a] an unreacted hydrocarbons stream [in 5th conduit] 185 and [b] an alkyl aromatic hydrocarbons stream [in 6th conduit] 190;

the unreacted hydrocarbons stream 185 comprising [a] at least a portion of the unreacted components of the second hydrocarbon stream 130 and [b] aromatic hydrocarbons;

[4] separating [in separator 160] [a1] at least a portion of the paraffins and [b1] at least a portion of the olefins from the unreacted hydrocarbons stream to produce [a2] an aromatic hydrocarbons stream [in 4th conduit] 170 and [b2] a paraffins and unreacted olefins stream 185; and

[5] introducing at least a portion of the paraffins and unreacted olefins stream into a dehydrogenation unit 180,

wherein the dehydrogenation unit 180 is configured to dehydrogenate at least a portion of paraffins in the paraffins and unreacted olefins stream to produce olefins, and

wherein at least a portion of the produced olefins exit the dehydrogenation unit to form an olefinic hydrocarbon stream [in 7th conduit] 195; and

[6] introducing at least a portion of the olefinic hydrocarbon stream 195 into the isomerization unit 110.

The overall process of claim 1 is further understood by reference to certain parts of the specification.

A first hydrocarbon stream containing olefins and paraffins is introduced into isomerization unit 110 via first conduit 120. Specification, page 15:12-13.

A feed stream comprising olefins and paraffins can be obtained through cracking of paraffin and/or oligomerization of olefins. Specification, page 12:26-27.

In isomerization unit 110, at least a portion of the olefins in the first hydrocarbon stream are isomerized to branched olefins to produce a second hydrocarbon stream. Specification, page 15:18-20

The conditions for olefin isomerization in isomerization unit 110 may be controlled such that the number of carbon atoms in the olefins prior to and subsequent to the isomerization conditions is substantially the same. U.S. Patent 5,648,584 (Murray, entitled "Process for Isomerizing Linear Olefins to Isoolefins") and U.S. Patent 5,648,585 (Murray et al., entitled "Process for Isomerizing Linear Olefins to Isoolefins") are said to describe, in detail, catalysts and process conditions to skeletally isomerize linear olefins to branched olefins. Specification, page 16:1-7.

Isomerization unit 110 produces a second hydrocarbon stream that includes olefins and paraffins. At least a portion of the second hydrocarbon stream contains branched olefins. Specification, page 20:24-25.

The second hydrocarbon stream exits isomerization unit 110 via second conduit 130 and is introduced into alkylation unit 140. Specification, page 20:26-27.

Alkylation of aromatic hydrocarbons by at least a portion of branched olefins produced in isomerization unit 110 may be conducted using various types of reactors. Specification, page 20:27-29.

For example, the alkylation process may be carried out in a batch wise fashion by adding the catalyst and aromatic hydrocarbons to a reactor,

heating the mixture to a reaction temperature, and then adding the olefinic and/or aromatic hydrocarbons to the heated mixture. Specification, page 20:29-31.

At least a portion of the olefins in the second hydrocarbon stream 130, produced by isomerization unit 110, is contacted with aromatic hydrocarbons (e.g., benzene) using a variety of alkylating conditions. Specification, page 21:21-23.

Alkylation catalysts can be used in alkylation unit 140, including zeolites in acidic form. Specification, page 24:1.

Suitable zeolite alkylation catalysts are described in U.S. Patent 6,111,158 (Marinangeli 2, entitled "Process for Producing Arylalkanes at Alkylation Conditions Using a Zeolite Having a NES Zeolite Structure Type") and U.S. Patent 5,041,402 (Schoennagel et al., entitled "Thermally Stable Noble Metal-Containing Zeolite Catalyst". Specification, page 24:9-15.

In alkylation unit 140, at least a portion of the olefins in the second hydrocarbon stream 130 and at least a portion of the aromatic hydrocarbons are reacted under alkylation conditions in the presence of the alkylation catalyst. Specification, page 26:4-6.

Alkylation reaction mixture stream 150 enters separator 160 via third conduit 150. Specification, page 27:12.

In separator 160 at least two streams, an unreacted hydrocarbons stream 185 and an alkyl aromatic hydrocarbon stream 190 are produced. Specification, page 27:13-14.

Separation of at least a portion of unreacted hydrocarbons from the produced branched alkyl aromatic hydrocarbons is accomplished by methods generally known (e.g., distillation, solid/liquid separation, adsorption, solvent extraction). Specification, page 27:14-16.

A portion of the separated aromatic hydrocarbons stream is recycled to alkylation unit 140 via fourth conduit 170. Specification, page 27:26-28.

A portion of the purified alkyl aromatic hydrocarbon product stream is transferred through sixth conduit 190 to be stored on site [not shown], sold commercially, transported off-site and/or utilized in other processing units [not shown]. Specification, page 28:11-14.

A portion of the separated paraffins and unreacted olefins are introduced into dehydrogenation unit 180 via fifth conduit 185. Specification, page 27:28-29 and page 30:1-2.

In the dehydrogenation unit 180, a portion of the unreacted paraffins in the hydrocarbon stream are dehydrogenated to produce an olefinic hydrocarbon stream by use of a wide range of catalysts. Specification, page 28:18-20.

Suitable procedures for preparing catalysts and performing the dehydrogenation step are described in (1) U.S. Patent 5,012,021 (Vora et al., entitled "Process For the Production of Alkyl Aromatic Hydrocarbons Using Solid Catalysts"); (2) U.S. Patent 3,274,287 (Moore et al., entitled "Hydrocarbon Conversion Process and Catalyst"); (3) U.S. Patent 3,315,007 (Abell et al., entitled "Dehydrogenation of Saturated Hydrocarbons Over Noble-Metal Catalyst"); (4) U.S. Patent 3,315,008 (Abell et al., entitled "Dehydrogenation of Saturated Hydrocarbons Over

Noble-Metal Catalyst"); (5) U.S. Patent 3,745,112 (Rausch, entitled "Platinum-Tin Uniformly Dispersed Hydrocarbon Conversion Catalyst and Process"); (6) U.S. Pat. No. 4,506,032 (Imai et al., entitled "Dehydrogenation Catalyst Composition") and (7) U.S. Patent 4,430,517 (Imai et al., entitled "Dehydrogenation Process Using a Catalytic Composition").

The olefinic hydrocarbon stream 195 is combined with first hydrocarbon stream in first conduit 120 of isomerization unit 110 via seventh conduit 195 and is then introduced into isomerization unit 110. Specification, page 30:17-20.

Examiner's rejection

In rejecting the claims on appeal, the Examiner found that all of the process steps called for by Shell's claim 1 are described in either Marinangeli 1 of Marinangeli 2. Examiner's Answer, pages 3-4.

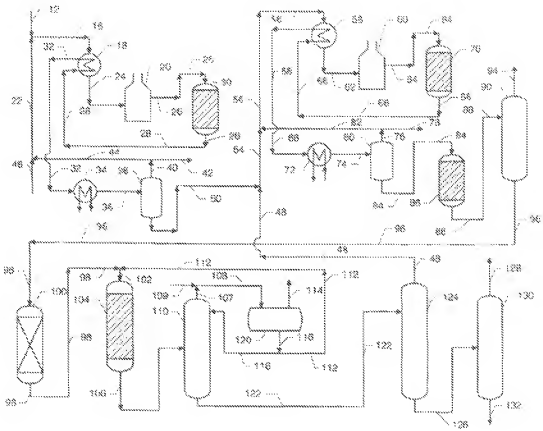
In essence, the Examiner held that it would have been obvious to one having ordinary skill in the art to use the known process steps to make branched alkyl aromatic hydrocarbons as set out in claim 1. Examiner's Answer, page 4; Final Rejection, page 4.

Prior art

The prior art relied upon by the Examiner (Marinangeli 1 and Marinangeli 2), as well as the prior art cited in the specification, confirm that all the process steps in claim 1 are being used for the intended purpose and each step performs precisely in the manner which one having ordinary skill in the art would have expected.

(1) Marinangeli 1

We start with the Marinangeli 1 drawing below.



With reference to claim 1 of Marinangeli 1and its drawing, Marinangeli 1 describes a process for producing arylalkanes comprising the steps of:

(a) passing a feed stream 26 containing paraffins to an isomerization zone 30, operating the isomerization zone at isomerization conditions sufficient to isomerize paraffins, and recovering from the isomerization

zone an isomerized product stream 28 comprising lightly branched paraffins [col. 29:46-52];

(b) passing at least a portion of the isomerized product stream 28 to a dehydrogenation zone 70, operating the dehydrogenation zone at dehydrogenation conditions sufficient to dehydrogenate paraffins [i.e., convert branched paraffins to branched olefins], and recovering from the dehydrogenation zone a dehydrogenated product stream 66 comprising branched monoolefins and branched paraffins, wherein at least a portion of the monoolefins in the dehydrogenated product stream 66 have 3 or 4 primary carbon atoms and no quaternary carbon atoms [col. 30:19-25];

(c) passing an aryl compound and at least a portion of the dehydrogenated product stream comprising monoolefins to an alkylation zone 104, operating the alkylation zone at alkylation conditions sufficient to alkylate the aryl compound with monoolefins in the presence of an alkylation catalyst to form arylalkanes comprising molecules having one aryl portion and one aliphatic alkyl portion [col. 31:18-23];

(d) recovering from the alkylation zone 104 an alkylate product stream 106 comprising arylalkanes 128 [from rerun column 130] and a recycle stream 48 [from paraffin column 124]comprising paraffins [col. 31:24-58]; and

(e) passing at least a portion of the recycle stream to the isomerization zone [not shown] or the dehydrogenation zone 70.

Dehydrogenation unit 70 of Marinangeli 1 functions in the same manner and produces the same result as Shell's dehydrogenation unit 180.

Both dehydrogenation units convert paraffins to olefins by taking hydrogen away from the paraffins to produce olefins.

Alkylation 104 of Marinangeli 1 functions in the same manner and produces the same result as Shell's alkylation unit 160. Both produce a branched chain alkylated aromatic compound.

Isomerization unit 30 of Marinangeli 1 is not involved in Shell's process. The product of isomerization unit 30 would be the feed into Shell's first conduit 120 before it mixes with product from 7th conduit 195.

While both Marinangeli 1 and Shell seek to obtain branched alkylated aromatic compounds, the difference between Shell's claim 1 and Marinangeli 1, as noted by the Examiner, is process steps take place in a different order.

(2) Marinangeli 2

Marinangeli 2 does not have a drawing.

In describing the prior art, Marinangeli 2 notes that a standard process for producing BAB [branched alkylbenzenes] involves oligomerizing light olefins to branched olefins and then alkylating benzene with the branched olefins in the presence of a catalyst. Col. 1:42-45. While Shell calls "oligomerizing" "isomerization," what Shell does in isomerization unit 110 and alkylation unit 130 is what Marinangeli 2 refers to as a standard process.

With reference to Marinangeli 2 claim 1, there is described a process for producing arylalkanes. Col. 18:41.

The process comprises contacting an olefin feed comprising monoolefin molecules having 3 or 4 primary carbon atoms with no quaternary carbon atoms [carbon atoms bonded to 4 other carbon atoms]

with an aryl compound [benzene] at alkylation conditions in the presence of a zeolite having an NES zeolite structure type, wherein the arylalkanes comprise molecules comprising one aliphatic alkyl portion and one aryl portion; the aliphatic alkyl portion has from about 8 to about 28 carbon atoms, has 2, 3, or 4 primary carbon atoms, and has no quaternary carbon atoms except for any quaternary carbon atom bonded by a carbon-carbon bond with a carbon atom of the aryl portion.

The alkylation described by Marinangeli 2 and the alkylation which occurs in Shell's alkylation unit 130 is the same.

As noted by the Examiner (Answer, page 4), Marinangeli 2 describes an isomerization step which converts linear olefins to branched olefins which can be used as an olefinic feedstock. Col. 9:64-66. The feedstock is the "olefin feed" mentioned above.

As further noted by the Examiner (Answer, page 4), Marinangeli 2 describes the reaction of the lightly branched monoolefins with an aryl compound, which can be benzene. Col. 10:19-20.

Rebuttal evidence

Shell does not rely on rebuttal evidence.

C. Discussion

Examiner's § 103 rejection

As noted earlier in the findings, Shell is using known process steps [(1) isomerization of olefins to branched olefins, (2) alkylation of branched olefins to aromatic compounds and (3) dehydrogenation of paraffins to produce olefins] for their known purpose all the while achieving an entirely predictable result.

Shell's principal attack on the Examiner's rejection is that the Examiner supposedly has failed to show adequate motivation for doing what Shell claims in claim 1.

What Shell is looking for is an express statement in the prior art that explicitly suggests the process step order set out in claim 1. We now know from *KSR Int'l Co. v. Teleflex, Inc.*, 127 S. Ct. 1727, 1741 (2007), that one need not seek out precise teachings directed to the specific subject matter claimed. Rather, one can take account of the inferences and creative steps that a person of ordinary skill in the art would employ. Further, as *KSR* notes, a person of ordinary skill is not an automaton. 127 S. Ct. at 1742.

Shell acknowledges that the Examiner held that it would have been obvious to place the dehydrogenation step after the alkylation step instead of between the isomerization step and the alkylation step. Appeal Brief, page 10. But, says Shell, the Examiner failed to cite a reference to support the Examiner's position. Id.

Part of the problem in this case is that Shell uses the term "isomerization" to mean one thing and Marinangeli 1 uses the term to mean something else. Shell means converting linear olefins to branched olefins. Marinangeli 1 means converting paraffins to olefins. However, any attempt to "hide" behind any wordsmith distinction is immediately "uncovered" by a penetrating analysis of the prior art as a whole.

In "isomerization" unit 30 Marinangeli 1 makes branched paraffins. The branched paraffins are converted to branched olefins in dehydrogenation unit 70. At this point, we now have branched olefins which can be reacted with aromatic compounds in alkylation unit 160. In essence, these

Marinangeli 1 steps correspond to what is going on in Shell's dehydrogenation unit 180 where paraffins are converted to olefins with subsequent branching in isomerization unit 110. What Marinangeli 2 reveals as olefins "oligomerized" to branched olefins is exactly what happens in Shell's "isomerization" unit 110. What Marinangeli 2 means by "oligomerization" is the same thing that Shell means by "isomerization."

Like Shell, Marinangeli 1 produces a mixture of olefins, paraffins and alkylated aromatic compound from the bottom stream 106 of alkylation unit 104. Also like Shell, Marinangeli 1 sends the paraffins to its dehydrogenator unit 70 to make olefins, which along with olefins already entering the dehydrogenator are ultimately used in the alkylation unit 104.

One having ordinary skill knows that one way to alkylate an aromatic compound is to react (1) a branched olefin with (2) an aromatic compound, e.g., benzene. Marinangeli 1, alkylation unit 104.

One having ordinary skill further knows that to obtain branched olefins, one can (1) take paraffins and make branched paraffins then dehydrogenate the branched paraffins to make branched olefins (that is Marinangeli 1 does, but not Shell) or (2) oligomerize linear olefins to make branched olefins (that is what both Marinangeli 2 and Shell do). See, e.g., Marinangeli 2, col. 2:42-44 and col. 9:64-66.

One having ordinary skill still further knows that if often makes sense, for cost efficiency and environmental reasons, to recycle. That is what both Marinangeli 1 and Shell do). See, e.g., Marinangeli 1, recycle conduit 48.

Shell is using known steps for their intended purpose to achieve nothing more than an expected result. Under the facts of this case, Shell has failed to overcome the § 103 hurdle.

We have not overlooked Shell's statement that the invention is said to provide "a method for producing alkylated aromatics that produce surfactants having excellent biodegradability and detergency at reduced production costs. Appeal Brief, page 7. First, Shell is not claiming surfactants. Second, Shell has not shown (or argued) that the products produced by the process of claim 1 lead to the allegedly improved surfactants. We therefore are unable to find based on the arguments made that there is any unexpected result associated with the process of claim 1.

The Examiner and Shell cite numerous cases. We are content to cite and rely on *KSR* and therefore do not find it necessary to address the cases cited by the Examiner and Shell.

We have considered Shell's remaining arguments and find none that warrant reversal of the Examiner's rejection(s). *Cf. Hartman v. Nicholson*, 483 F.3d 1311, 1315 (Fed. Cir. 2007).

D. Decision

Shell has not sustained its burden on appeal of showing that the Examiner erred in rejecting the claims on appeal as being unpatentable under 35 U.S.C. § 103 over the prior art.

On the record before us, Shell is not entitled to a patent containing claims 1-43.

Upon consideration of the appeal, and for the reasons given herein, it is

ORDERED that the decision of the Examiner rejecting claims 1-43 over the prior art is *affirmed.*

FURTHER ORDERED that no time period for taking any subsequent action in connection with this appeal may be extended under 37 C.F.R. § 1.136(a)(1)(iv) (2008).

AFFIRMED

rvb

cc (via First Class mail)

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